

**SUMMARY OF PACIFIC SALMON CODED-WIRE TAG APPLICATION  
AND RECOVERY, PRINCE WILLIAM , 1994**



by

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## **PREFACE**

This report was prepared as part of cooperative agreements between the Alaska Department of Fish and Game, the Prince William Sound Aquaculture Association, and the Valdez Fisheries Development Association for State Fiscal Year 1995.

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## INTRODUCTION

Primary reporting duties for the Prince William Sound Pink Salmon Coded-Wire Tag Project have been associated with generation of technical reports for the Exxon Valdez Oil Spill Trustee Council. While these reports provide much technical information, they do not evaluate day-to-day project operations and may not present all information desired by cooperating private non-profit aquaculture associations, Prince William Sound Aquaculture Corporation (PWSAC) and Valdez Fishery Development Association (VFDA). In order to better address the information needs of the aquaculture associations, the Alaska Department of Fish and Game (ADF&G) agreed to write a separate annual report which summarized tagging and tag recovery activities, presented estimates of hatchery contributions by fishing period rather than week, and provided survival rates of pink salmon by tag code.

The 1994 pink salmon return to Prince William Sound was one of the largest on record and the total number harvested was 37.99 million. Of this total harvest, 26.17 million were taken during common property fisheries, 10.37 million were taken during cost recovery fisheries, and 1.38 million were taken as brood stock. Runs to Solomon Gulch and Cannery Creek hatcheries were strong, the run to Wally Noerenberg was average, and the run to A.F. Koernig was weak. Wild stock runs were generally strong.

## METHODS

### *Applying Tags*

Four hatcheries produce pink salmon in Prince William Sound. Tagging procedures are similar at all hatcheries and are described in detail in the 1994 Coded Wire Tag Project Report to the Exxon Valdez Oil Spill Trustee Council. Fry to be tagged are randomly selected from their release group, marked, and released with their cohorts. Usually, about one pink salmon fry in every 600 is tagged. In 1994, several release group in an experimental growth study were tagged at a rate of one per 200 fry.

### *Recovering Tags*

Tag are recovered from pink salmon harvested during common property and cost recovery fisheries after each opening. As pink salmon are pumped from tenders onto conveyer belts in processing plants, ADF&G technicians count and sample pink salmon with a missing adipose fin. We attempt to sample about 20 percent of the total harvest in this manner to ensure that a sufficient number of tags are collected to produce accurate and precise estimates of hatchery contributions.

### *Estimating Hatchery Contributions*

For this report, common property and cost-recovery fishery samples were stratified by district, period, and processor. Since the RBase computer program normally used in calculating hatchery contributions could not readily be altered from the original stratification of district, week, and processor, hatchery contribution estimates for this report were calculated on Lotus spreadsheets developed by Samuel Sharr, the former Principal Investigator for this program. Equations used for calculations are presented in the following paragraphs.

The contribution of release group  $t$  to the sampled common property, cost-recovery harvests, and escapement,  $C_t$ , was estimated as:

$$\hat{C}_t = \sum_{i=1}^L x_{it} \left( \frac{N_i \hat{a}}{s_i p_t} \right), \quad (1)$$

where

- $x_{it}$  = number of group  $t$  tags recovered in the  $i$ th stratum,
- $N_i$  = total number of fish in the  $i$ th stratum,
- $s_i$  = number of fish sampled from the  $i$ th stratum,
- $p_t$  = proportion of group  $t$  tagged,
- $a$  = historical adjustment factor associated with W. Noerenberg facility; and,

$L$  = number of recovery strata associated with common property, cost-recovery, brood stock, special harvests and escapement in which tag code  $t$  was found.

The adjustment factor for hatchery  $h$ ,  $a_h$ , was estimated as the ratio of sampled fish in the brood stock to the expanded number of fish based on tags found in the sample :

$$\hat{a}_h = \frac{s_h}{\sum_i \frac{x_i}{p_i}}, \quad (2)$$

where

$T$  = number of tag codes released from hatchery  $h$ ,

$p_i$  = tagging rate at release for the  $i$ th tag code (defined as number of tagged fish released with the  $i$ th code divided by the total number of fish in release group  $i$ ),

$x_i$  = number of tags of the  $i$ th code found in  $s_h$

and,

$s_h$  = number of brood stock fish examined in hatchery  $h$ .

The purpose of an adjustment factor is to remedy violations of assumptions that 1) mortality of tagged and untagged pink salmon within a release group is the same, and 2) marked pink salmon do not lose tags. The adjustment factor used in 1994 was calculated as the mean of all W. Noerenberg Hatchery adjustment factors for the period 1989-1994. An adjustment factor based only on data from W. Noerenberg Hatchery used for all hatcheries since this is the only facility at which significant number of pink salmon from either wild runs or other hatcheries do not occur in brood ponds. Pink salmon straying from other hatcheries or wild runs are thought to inflate adjustment factors calculated for other hatcheries.

The contribution of release group  $t$  to unsampled strata,  $Cu_t$ , was estimated from contribution rates associated with strata which



were sampled from the same district-week openings as the unsampled strata:

$$\hat{C}_{u_t} = \sum_{i=1}^U \left[ N_i * \frac{\left( \sum_{j=1}^S \hat{C}_{tj} \right)}{\frac{\sum_{j=1}^S N_j}{S}} \right], \quad (3)$$

where

- $U$  = number of unsampled strata,
- $N_i$  = number of fish in  $i$ th unsampled stratum
- $S$  = number of strata sampled in the period in which the unsampled stratum resides,
- $C_{tj}$  = contribution of release coded with tag  $t$  to the sampled stratum  $j$ , and
- $N_j$  = number of fish in  $j$ th sampled stratum.

A variance approximation for  $\hat{C}_t$ , derived by Clark and Bernard (1987) and simplified by Geiger (1990) was used:

$$\hat{V}(\hat{C}_t) = \sum_{i=1}^L x_{it} \left[ \frac{N_i \hat{a}}{s_i p_t} \right] \left[ \frac{N_i \hat{a}}{s_i p_t} - 1 \right]. \quad (4)$$

Summation of variance components over all tag codes provided an estimate of the variance of the total hatchery contribution.

### ***Estimating Survival Rates***

The survival rate of the release group coded with tag  $t$  ( $S_t$ ), was estimated as:

$$\hat{S}_t = \frac{\hat{C}_t + \hat{C}_{u_t}}{R_t}, \quad (5)$$

where

- $C_t$  = contribution of release group coded with tag  $t$  to sampled strata,
- $Cu_t$  = contribution of release group coded with tag  $t$  to unsampled strata,
- $R_t$  = total number of fish in release group coded with tag  $t$  released from hatchery.

Assuming the total release of pink salmon associated with a tag code is known with negligible error, and that the cumulative variance contributions associated with the unsampled strata are small, a suitable variance estimate for  $\hat{S}_t$  is given by:

$$\hat{V}(\hat{S}_t) = \frac{\sum_{i=1}^L x_{it} \left[ \frac{N_i \hat{a}}{s_i p_t} \right] \left[ \frac{N_i \hat{a}}{s_i p_t} - 1 \right]}{R_t^2}. \quad (6)$$

## RESULTS AND DISCUSSION

I was not present in Prince William Sound during the 1994 tagging and tag recovery periods, and Samuel Sharr, the former Principal Investigator, no longer lives or works in the area. Therefore, I obtained some information for this report from interviews with PWSAC and VFDA hatchery personnel as well as ADF&G staff working in Prince William Sound during this time.

### *Applying Tags In 1994*

#### **A.F. Koernig Hatchery**

According to Kirk Lingofelt, the Fish Culturist at A.F. Koernig Hatchery, the 1994 pink salmon fry migration occurred faster than usual, which challenged the tagging crews. In addition, one rearing treatment group (Max Growth), represented by tag codes 1301030303 and 1301030304, was tagged at a rate of one in 200 fry

(Table 1). Tagging crews were required to work 8 to 10 hours a day, seven days a week, in order to maintain desired tagging rates throughout the migration period. Also, due to high mortality in one release group, represented by tag code 1301030108, at the time of migration, the tag rate for this group of fry was one in 493. Finally, the release group tagged with code 1301030207 were prematurely dumped into the general population pen, resulting in a tag rate of one in 628.

Differential tagging rates can present problems in calculating inseason estimates of hatchery contributions. Release groups with tagging rates of one in 493 and one in 628 can cause, respectively, over- or underestimates of hatchery contributions. However, tagging at these rates probably don't deviate enough from one in 600 to be of much concern, unless survival rates differ greatly among release groups. However, the treatment group tagged at one in 200 could cause a large overestimate of the hatchery contribution, particularly if that treatment group has a survival at least twice that of other groups released from this hatchery. A one in 200 tagging rate was set to increase the power of statistical tests to be used for a pink salmon fry marine growth study being conducted as part of the Exxon Valdez damage assessment and restoration program. Unfortunately, the ADF&G biologist in charge of the coded-wire tag recovery program was not informed of this change from the one in 600 tagging rate until these fry had already been released. To avoid these types of problems in the future, both the tag application and recovery portions of this program have been placed under the direction of one ADF&G biologist.

While differential tagging rates can bias results of inseason estimates based on detected tags, it will not bias results of inseason estimates based on decoded tags. ADF&G is planning to make inseason estimates of hatchery contributions from decoded tags for at least the first two fishery openings in the Southwestern District. These samples will be processed by the ADF&G Tag Laboratory in Juneau on a priority basis, so that information on decoded tags will be available within 48 hours from the time the samples are received by the Laboratory. Inseason hatchery contribution estimates based on decoded tags will then be available about five to seven days after the first opening, and will be used to alert us of any problems with making estimates based on detected tags.

## **Main Bay Hatchery**

This facility produces chum, coho, chinook, and sockeye salmon. Only sockeye salmon were tagged in 1994 (Table 2). Charles Pratt, PWSAC, reported that Main Bay Hatchery had few problems during tagging, aside from lack of a precise scale for weighing out anesthesia and baking soda.

## **W. Noerenberg Hatchery**

This facility produces pink, chum, coho, and chinook salmon (Tables 1 and 2). Malfunctioning tagging machines presented difficulties at W. Noerenberg Hatchery. One machine's quality control device (QCD) rejected properly tagged fish, while a second machine jammed repeatedly. In addition, an early migration of pink salmon fry resulted in hatchery personnel having to assist in tagging since the full tagging crew was not able to report on short notice. Use of inexperienced personnel coupled with malfunctioning tagging machines may have greatly increased poor tag placement as well as tag loss.

Additionally, one tag code had to be voided when a bucket of tagged pink salmon fry was placed in the wrong pen, and two groups of pink salmon fry were tagged at a rate of one in 200. Both of these circumstances could introduce biases into inseason hatchery contribution estimates, which could be overestimated. The seriousness of this problem will depend upon survival rates of the release groups and tag codes in question.

Chum, coho and chinook salmon tag application proceeded with fewer problems than encountered in tagging pink salmon. Chinook salmon had to be released early due to mortalities from bacterial kidney disease.

## **Cannery Creek Hatchery**

In response to high pink salmon fry mortality rates, extra fry were tagged so that additional fry did not need to be tagged after tag codes were completed. The tagging rate for all release groups was very close to 1 in 600 (Table 1). Some mechanical problems were encountered with tagging machines, but these appeared to be the result of radio interference. In an effort to

gain a better understanding of tag retention and tagging mortality, the observation period for tag losses and post-tagging mortalities was extended from 72 hours to 7 days.

### **Solomon Gulch Hatchery**

Reliable estimates of the number of pink salmon fry in each release group were not obtained at this facility prior to allowing fry to migrate into holding pens (Table 1). Furthermore, some tag codes were interspersed among three pens. This made it impossible to directly calculate tagging rates. To obtain an estimate of release group numbers, approximately 100,000 fry were sampled from each pen and passed through a tag detector. The number of fry examined was calculated by multiplying the number of scoops passed through the tag detector by an estimate of the mean number of fry per scoop. Tagging rates were calculated by dividing the number of detected tags by 100,000. Release group sizes were calculated by dividing the total number of fry tagged by the tagging rate. Associated variances were calculated using a bootstrap method. The indirect calculation of release group sizes adds another level of variation to estimates of Solomon Gulch hatchery contributions. The variance around hatchery contribution estimates will have to be calculated separately from programs and spreadsheets presently being used.

Unlike pink salmon tagging, chum and coho salmon tagging proceeded smoothly (Table 2).

### ***Hatchery Contributions To 1994 Harvest***

Hatchery contributions of pink salmon to common property fisheries within each district were estimated for each period of the 1994 fishing season (Table 3). Hatchery contributions of pink salmon to cost recovery fisheries within each district were estimated by date for the 1994 season (Table 4). Hatchery contribution estimates by period or date are similar to those calculated by statistical week. Some disparities may be found, however, due to the different way in which data were stratified (period versus statistical week), and the use of small sample sizes to partition some period catches.

## **Common Property Harvest**

In 1994, pink salmon produced by Solomon Gulch Hatchery comprised the largest portion of the common property harvest (Table 3). The remaining harvest was produced, in order of abundance, by Cannery Creek Hatchery, wild stocks, W. Noerenberg Hatchery, and A.F. Koernig Hatchery. In general, the largest contributor to a district was the nearest hatchery producing pink salmon. The exception was Southwestern district, where W. Noerenberg and Cannery Creek hatcheries, as well as wild stocks, contributed more to the district catches than did A.F. Koernig Hatchery.

## **Cost Recovery Harvest**

Cost recovery harvests were stratified into two-day segments to reduce the number of calculations required in analyses (Table 4).

Also, daily harvests were not sampled in all cases, so a number of daily strata would have had to be combined. In general, contributions to cost recovery harvests from hatcheries other than the one of origin were small. Eshamy District was an notable exception. Since Main Bay hatchery produces only sockeye salmon, only one stratum was sampled for pink salmon during cost recovery harvests. This stratum was then used to partition harvests in all other strata. Therefore, hatchery contributions to cost recovery harvests by date for this facility do not accurately represent entry patterns of pink salmon stocks into Eshamy District.

## ***Survival Rates by Tag Code***

Late fed release groups of pink salmon fry had consistently higher survival rates than early or mid fed groups for both A.F. Koernig and W. Noerenberg hatcheries, although differences between early and late fed fry were most marked for A.F. Koernig hatchery (Table 5). Fry released directly into the marine environment generally had lower survival rates than early fed fry.

No consistent trends in survival rates were apparent for Cannery Creek pink salmon fry (Table 5). One direct release group had a higher survival rate than two of the late fed release groups, and

one of the late fed release groups had the lowest survival rate for that facility.

Pink salmon fry survival rates among hatcheries showed a trend of decreasing survival counterclockwise around Prince William Sound from the northeastern corner. Solomon Gulch Hatchery had the highest survival rates, Cannery Creek had slightly lower ones, and Solomon Gulch and A.F. Koernig had the lowest rates. Environmental factors which could have caused this trend include water circulation patterns, food availability, and presence of predators.

Marine survival rates for pink salmon are relatively easy to calculate, since they return one year after being released. By contrast, chinook, chum, and sockeye salmon return over several years. Therefore, each age group that returns from a release group will have an overall survival rate comprised of one to five different marine survival rates which must be weighted by the proportion of each release group that returns in a given year.

Survival rates for coho salmon are usually easier to calculate, assuming that the number of precocious males returning (early) is negligible.

## CONCLUSIONS

- 1) Hatchery production of pink salmon in Prince William Sound, with the exception of A.F. Koernig Hatchery, was very good in 1994.
- 2) Reasons for low survival rates of A.F. Koernig pink salmon are not known at this time.
- 3) Differential tagging rates of experimental groups may present problems for inseason estimation of hatchery contributions in 1995 harvests.

**Table 1.** Hatchery releases of pink salmon into Prince William Sound during 1994.

Origin	Tag Code	# Tagged	# Released	Rearing Strategy
A.F. Koernig	1301030108	13,427	6,618,697	Early Fed
	1301030303	17,732	3,547,896	Max Growth
	1301030304	17,481	3,496,392	Max Growth
	1301030109	10,541	6,324,498	Early Fed
	1301030110	9,213	5,527,509	Early Fed
	1301030111	9,741	5,844,629	Early Fed
	1301030113	9,179	5,507,274	Early Fed
	1301030114	10,208	6,125,031	Early Fed
	1301030115	8,570	5,142,018	Early Fed
	1301030201	8,243	4,946,477	Early Fed
	1301030202	10,577	6,345,996	Early Fed
	1301030203	10,794	6,476,718	Early Fed
	1301030204	11,143	6,685,569	Early Fed
	1301030205	10,450	6,270,226	Direct Release
	1301030206	11,368	6,821,127	Late Fed
	1301030207	10,191	6,398,894	Late Fed
	N/A		644,630	Direct Release
W. Noerenberg	1301020401	15,977	9,371,367	Early Fed
	1301021214	2,229	1,300,230	Direct Release
	1301021312	18,674	11,211,336	Early Fed
	1301021313	19,208	11,540,914	Early Fed
	1301021314	19,917	12,040,148	Early Fed
	1301021315	19,744	11,872,060	Early Fed
	1301021401	20,181	12,163,694	Early Fed
	1301021402	19,976	19,976	Void
	1301021403	20,324	12,055,003	Early Fed
	1301021404	20,706	12,328,148	Early Fed
	1301021405	20,214	12,126,815	Early Fed
	1301021406	20,098	12,106,415	Early Fed
	1301021407	20,113	12,214,122	Early Fed
	1301021408	20,385	12,336,261	Early Fed
	1301021409	19,965	12,010,977	Early Fed
	1301030305	18,990	3,803,426	Max Growth
	1301030306	19,469	3,905,582	Max Growth
Cannery Creek	1301021513	16,084	9,485,711	Early Fed
	1301021514	15,523	9,329,671	Early Fed
	1301021515	15,793	9,492,115	Early Fed
	1301030101	15,691	9,429,516	Mid Fed
	1301030102	15,797	9,494,035	Mid Fed
	1301030103	16,252	9,767,701	Mid Fed
	1301030104	16,434	9,876,333	Late Fed
	1301030105	15,961	9,580,712	Late Fed
	1301030106	13,569	8,160,820	Late Fed
Solomon Gulch 1/	1301030209	49,718	28,140,000	
	1301030210	49,513	29,370,000	
	1301030211	50,381	24,170,000	
	1301030212	53,421	23,740,000	
	1301030213	68,860	47,880,000	2/
	1301030214	33,785		2/

1/ Sizes of release groups are Petersen estimates.

2/ Tag codes interspersed in 3 pens



**Table 2.** Hatchery releases of sockeye, chum, coho, and chinook salmon into Prince William Sound during 1994.

Origin	Tag Code	# Tagged	# Released	Rearing Strategy	
Main Bay Sockeye	312340	4,253	90,358	Rel. Size 6 g.	
	312341	19,070	761,797	Rel. Size 7 g.	
	312342	10,956	438,653	Rel. Size 10 g.	
	312343	16,512	659,872	Rel. Size 6 g.	
	312344	16,280	662,584	Rel. Size 6 g.	
	312345	16,254	649,557	Rel. Size 10 g.	
	312346	22,237	889,158	Rel. Size 8 g.	
	312347	17,311	691,633	Rel. Size 7 g.	
W. Noerenberg Chum	1301021410	11,826	5,943,864	Early Fed	
	1301021411	12,338	6,128,964	Early Fed	
	1301021412	12,050	6,012,997	Mid May Rel.	
	1301021413	11,964	5,962,398	Mid May Rel.	
	1301021414	12,300	6,150,049	Mid May Rel.	
	1301021415	12,029	6,028,114	Mid May Rel.	
	1301021501	11,915	6,019,689	Mid May Rel.	
	1301021502	12,281	6,103,021	Late Fed	
	1301021503	11,861	5,922,300	Late Fed	
	1301021504	12,038	6,015,599	Late Fed	
	1301021505	12,075	6,045,954	Early Fed	
	1301021506	11,454	5,729,197	Early Fed	
	1301021507	11,889	5,966,058	Early Fed	
	1301021508	11,827	5,955,702	Early Fed	
	1301021509	7,733	3,904,646	Early Fed/1.5g	
	1301021510	7,628	3,794,514	Early Fed/1.5g	
	1301021511	7,966	3,989,942	Late Fed/1.5g	
	1301021512	9,131	4,435,190	Late Fed	
	Coho	312306	37447	1484936	
	Chinook	312307	19,734	394,606	On Site Rel.
312308		4,923	98,302	Whittier Rel.	
312309		4,974	99,334	Cordova Rel.	
312310		2,524	50,318	Chenega Rel.	
Solomon Gulch Chum	1301030215	10,896	3,439,725		
	1301030302	8,392	2,648,338		
Coho	312348	23,761	901,303		
	312349	108	13,784		

**Table 3.** Pink salmon hatchery and wild stock contributions to Prince William Sound common property fisheries by district and period during 1994.

Eastern District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
06/30	1	0		0		0		216346	3.1E+08	216346	3.1E+08	21678	238024	99
7/03-7/04	2	0		0		0		1069759	8.1E+09	1069759	8.1E+09	174468	1244225	233
07/08	3	0		0		0		839508	4.4E+09	839508	4.4E+09	332667	1172175	113
07/10	4	0		0		0		1148744	1.4E+09	1148744	1.4E+09	258739	1405483	190
07/13	5	0		0		0		1055243	1.2E+09	1055243	1.2E+09	202508	1257751	183
07/17	6	0		0		0		2123837	1.7E+09	2123837	1.7E+09	509269	2633106	288
07/20	7	8315	55601456	0		0		1226750	1.4E+09	1235085	1.5E+09	341919	1576984	231
07/22	8	7926	48550649	0		0		413732	7.3E+08	421658	7.8E+08	72720	494378	67
07/24	9	0		10791	90481530	0		513487	3.5E+09	524278	3.6E+09	16809	541087	109
07/27	11	0		0		20888	81623152	345338	4.8E+08	366226	5.6E+08	198185	564411	92
07/30	12	2115	1911677	2115	1911677	0		141645	1.6E+08	145875	1.6E+08	75880	221755	
08/03	14	0		0		0		6340	28808261	6340	28808261	78258	84598	1
08/05	15	0		0		29770	1.1E+08	8687	24121166	38457	1.3E+08	81363	119820	10
08/09	16 1/	0		0		129	2080	38	456	167	2536	354	521	
Subtotal		18356	1.1E+08	12906	92393207	20888	81623152	4764789	8.0E+09	4816839	8.3E+09	1214782	6031721	787

1/ Proportions from period 15 were used to partition the catch.

Northern District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
07/22	8	0		0		0		28886	64863995	28886	64863995	9271	38157	28
07/30	12	0		0		293014	2.2E+09	0		293014	2.2E+09	7251	300265	20
08/01	13	0		22104	1.2E+08	595519	1.3E+09	0		617623	1.4E+09	402665	1020288	130
08/03	14	0		13376	90901382	177744	5.6E+08	5605	27377623	196725	7.0E+08	28232	224957	46
08/05	15	0		0		22188	85648652	0		22188	85648652	35904	58092	4
08/09	16	0		119303	1.5E+09	1190214	4.8E+09	0		1309517	6.3E+09	329635	1639152	159
08/11	17	10029	93882235	177035	1.4E+09	611066	3.8E+09	0		798130	5.3E+09	114900	913030	101
08/13	18	0		176420	1.7E+09	745950	5.3E+09	0		922370	7.0E+09	2509	924879	77
08/15	19	4103	15540965	161792	5.8E+08	527785	1.7E+09	0		693680	2.3E+09	27740	721420	132
08/17	20	0		30589	1.8E+08	144320	6.3E+08	0		174909	8.1E+08	77400	252309	43
08/19	21	6097	19168002	166303	4.5E+08	98855	2.9E+08	0		271255	7.6E+08	5604	276859	37
08/21	22	0		4466	16315234	130742	1.0E+09	0		135208	1.0E+09	66062	201270	20
08/23	23 2/	0		1600	2096563	46869	1.3E+08	0		48469	1.3E+08	23681	72150	
8/25-8/27	24	0		10732	51873474	11837	23680204	0		22569	75533678	116425	138994	11
Subtotal		20229	1.3E+08	883720	6.1E+09	4596103	2.2E+10	34491	92241618	5534543	2.8E+10	1247279	6781822	808

2/ Proportions from period 22 were used to partition the catch.

**Table 3.** Page 2 of 4.

Coghill District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
6/13-6/14	1 GN	0		0		0		32	1027820	32	1027820	0	32	1
6/16-6/17	2 GN	0		0		0		0		0	0	181	181	0
06/20	3 GN	0		0		0		0		0	0	208	208	0
06/27	4 GN	0		0		0		0		0	0	345	345	0
07/01	5 GN	0		0		0		0		0	0	121	121	0
7/04-7/05	6 GN	0		0		0		0		0	0	242	242	0
7/07-7/08	7 GN	0		0		0		5	1027820	5	1027820	106	111	1
7/11-7/12	8 GN	0		0		0		101	2055639	101	2055639	316	417	1
7/14-7/15	9 GN	0		0		0		0		0	0	299	299	0
7/18-7/19	10 GN	0		0		0		0		0	0	422	422	0
7/21-7/22	11 GN	0		0		0		2297	1894746	2297	1894746	254	2551	2
7/25-7/26	12 GN	0		0		2117	4480644	1051	5.6E+08	3168	5.6E+08	1801	4969	2
08/09	13 GN 16 S	4110	13322663	479564	2.3E+09	108731	5.9E+08	4110	13322663	596515	2.9E+09	0	596515	116
08/11	14 GN 17 S	0		313948	1.1E+09	85161	2.0E+08	0		399109	1.3E+09	0	399109	87
08/13	15 GN 18 S	3704	13329550	170970	9.3E+08	153044	6.1E+08	0		327718	1.6E+09	64100	391818	87
08/15	16 GN 19 S	0		276777	8.2E+08	79609	1.3E+08	0		356386	9.5E+08	77429	433815	84
08/17	20 S	0		182086	1.3E+09	35485	2.6E+08	0		217571	1.6E+09	196196	413767	41
08/19	21 S	6658	32964527	151122	3.3E+08	16822	59587136	0		174602	4.2E+08	103041	277643	55
08/21	22 S	0		57029	1.2E+08	43701	2.4E+08	0		100730	3.6E+08	111887	212617	30
8/23-8/24	20 GN 23 S	0		327027	1.0E+10	73082	4.6E+08	0		400109	1.0E+10	2819	402928	37
8/25-8/27	21 GN 24 S	4581	10031586	93929	4.4E+08	38329	2.5E+08	0		136839	7.0E+08	31721	168560	36
8/28-8/31	22 GN 25 S	0		158941	2.9E+08	30505	1.2E+08	0		189446	4.1E+08	6028	195474	45
9/01-9/05	23 GN 26 S	0		79722	93185831	9303	19332088	0		89025	1.1E+08	5952	94977	43
9/05-9/10	24 GN	0		2069	2055639	0		0		2069	2055639	108	2177	2
Subtotal		19053	69648326	2293184	1.8E+10	675889	2.9E+09	7596	5.8E+08	2995722	2.1E+10	603576	3599298	670

**Table 3.** Page 3 of 4.

Eshamy District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
7/07-7/08	1	0		0		0		0		0	0	676	676	0
7/11-7/12	2	0		0		0		0		0	0	2816	2816	0
7/14-7/16	3	0		0		0		0		0	0	4628	4628	0
7/18-7/20	4	0		0		0		0		0	0	5787	5787	0
7/21-7/23	5	0		0		0		0		0	0	7293	7293	0
7/28-7/29	6	0		0		0		0		0	0	9731	9731	0
8/01-8/02	7	0		4277	6140508	0		0		4277	6140508	7257	11534	3
8/04-8/06	8	2565	5753506	10259	17260517	2565	5753506	0		15389	28767529	22301	37690	6
08/08	9	12679	17785628	51330	46705251	8028	10748480	0		72037	75239359	2854	74891	18
08/11	10	11953	65997749	80986	3.0E+08	9719	61009288	0		102658	4.3E+08	23983	126641	27
08/15	11	6477	10483675	49253	73385728	0		0		55730	83868403	3374	59104	17
08/18	12	3775	14243511	22647	85461064	3375	14243511	0		29797	1.1E+08	50480	80277	8
08/22	13	18140	85895165	66444	2.9E+08	2650	8262482	0		87234	3.8E+08	0	87234	21
08/25	14	10554	24746616	32418	70994149	0		0		42972	95740765	3658	46630	14
8/29-8/30	15	2340	1216113	7186	3488837	0		0		9526	4704950	811	10337	
Subtotal		68483	2.3E+08	324800	8.9E+08	26337	1.0E+08	0		419620	1.2E+09	145649	565269	114

3/ Proportions from period 14 were used to partition the catch.

Southwestern District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
07/25	10	18351	90435584	40859	2.0E+08	35834	1.4E+08	59994	2.1E+08	155038	6.4E+08	49228	204266	24
07/30	12	133787	9.4E+08	213475	1.4E+09	167353	1.1E+09	30855	2.2E+08	545470	9.4E+08	155949	701419	62
08/01	13	52811	3.2E+08	64694	2.7E+08	141950	7.8E+08	0		259455	9.4E+08	218463	477918	32
08/03	14	220305	6.7E+08	157734	6.7E+08	276725	9.8E+08	19409	1.1E+08	674173	2.4E+09	371949	1046122	117
08/05	15	91041	1.1E+08	341877	2.5E+09	0		0		432918	2.7E+09	545449	978367	117
Subtotal		516295	2.1E+09	818639	5.1E+09	621862	3.0E+09	110258	5.4E+08	2067054	7.6E+09	1341038	3408092	352

**Table 3.** Page 4 of 4.

Unakwik District

Date	Period	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
		Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
08/09	16 4/	0		3192	1073524	31841	3435277	0		35033	4508801	8818	43851	
08/13	18 5/	0		12120	8023173	51246	25013422	0		63366	33036595	172	63538	
08/15	19 6/	601	33979	23718	1246357	77371	36533460	0		101690	37813796	4067	105757	
08/17	20 7/	0		3927	2966212	18526	10381740	0		22453	13347952	9936	32389	
08/19	21	0		0		38073	94425872	0		38073	94425872	0	38073	11
08/21	22	0		0		56498	2.5E+08	0		56498	2.5E+08	0	56498	7
08/23	23	0		0		25634	59488015	0		25634	59488015	6986	32620	4
8/25-8/27	24 8/	0		0		8224	6122658	0		8224	6122658	2241	10465	
8/28-8/31	25 8/	0		0		4723	2019345	0		4723	2019345	1287	6010	
Subtotal		601	33979	42957	13309266	312136	4.9E+08	0		355694	5.0E+08	33507	389201	22

4/ Proportions from Northern district common property harvest for period 16 were used to partition the catch.

5/ Proportions from Northern district common property harvest for period 18 were used to partition the catch.

6/ Proportions from Northern district common property harvest for period 19 were used to partition the catch.

7/ Proportions from Northern district common property harvest for period 20 were used to partition the catch.

8/ Proportions from Northern district common property harvest for period 23 were used to partition the catch.

**Table 4.** Pink salmon hatchery and wild stock contributions to Prince William Sound cost recovery fisheries by district and period during 1994.

Eastern District

Date	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
6/20-6/21	0		0		0		65536	1.5E+08	65536	1.5E+08	0	65536	14
6/22-6/23	0		0		0		71137	34692840	71137	34692840	0	71137	34
6/24-6/25	0		0		0		128466	24060215	128466	24060215	0	128466	72
6/26-6/27	0		0		0		213471	94876141	213471	94876141	17901	231372	49
6/28-6/29	0		0		0		378077	54941697	378077	54941697	30487	408564	102
7/01-7/02	0		0		0		442103	2.1E+08	442103	2.1E+08	16276	458379	74
07/05	0		0		0		68340	46689828	68340	46689828	28110	96450	20
7/06-7/07	0		0		0		363163	87658617	363163	87658617	27350	390513	95
07/09	0		0		0		100294	74380087	100294	74380087	18946	119240	26
07/11-7/12	0		0		0		245656	94170206	245656	94170206	205117	450773	62
7/14-7/15	0		0		0		287186	81315116	287186	81315116	107604	394790	78
07/16	0		0		0		106584	22521093	106584	22521093	45872	152456	55
07/19	0		0		0		46212	29566664	46212	29566664	24452	70664	19
07/21	0		0		0		139073	37167086	139073	37167086	4230	143303	51
07/23 1/							197	75	197	75	6	203	
Subtotal	0	0	0	0	0	0	2655495		2655495	1.0E+09	526351	3181846	751

1/ Proportions from 07/21 were used to partition the catch.

Northern District

Date	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
7/29-7/30	0		0		35979	99086845	0		35979	99086845	33262	69241	16
7/31-8/01	0		0		40358	29680949	0		40358	29680949	36231	76589	14
8/02-8/03	0		0		36186	67830020	0		36186	67830020	21708	57894	16
8/04-8/05	0		4617	5121103	201790	1.3E+08	0		206407	1.4E+08	170855	377262	43
8/06-8/07	0		0		808808	2.1E+09	0		808808	2.1E+09	276882	1085690	128
8/08-8/09	0		0		370762	1.4E+09	0		370762	1.4E+09	126058	496820	60
8/10-8/11	0		0		161022	8.3E+08	0		161022	8.3E+08	84371	245393	26
8/12-8/13	0		0		213911	8.2E+08	0		213911	8.2E+08	162157	376068	9
8/14-8/15	0		0		90917	3.1E+08	0		90917	3.1E+08	35201	126118	16
8/16-8/17	0		0		111643	3.5E+08	0		111643	3.5E+08	82847	194490	24
08/18	0		0		68351	3.5E+08	0		68351	3.5E+08	97306	165657	11
08/20 2/	0		0		24839	46222760	0		24839	46222760	35362	60201	
08/22 2/	0		0		33221	82678248	0		33221	82678248	47293	80514	
08/24 2/	0		0		36516	99899245	0		36516	99899245	51985	88501	
08/28 2/	0		0		23932	42909097	0		23932	42909097	34071	58003	
Subtotal	0	0	4617	5121103	2258235	6.8E+09	0		2262852	6.8E+09	1295589	3558441	363

2/ Proportions from 8/18 were used to partition catch

**Table 4.** Page 2 of 3.

Coghill District

Date	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
07/24	0		0		0		0		0	0	555	555	0
07/28	0		9505	12228058	0		0		9505	12228058	0	9505	8
07/31 +	0		31376	1.1E+08	0		0		31376	1.1E+08	10594	41970	14
8/02-8/03 *	0		58881	38302996	2879	2812006	0		61760	41115002	41526	103286	22
8/04-8/05	0		109508	80766491	0		0		109508	80766491	0	109508	30
8/06-8/07	0		181043	3.2E+08	19731	53477197	0		180774	3.7E+08	0	180774	21
08/08	0		263669	4.1E+08	0		0		263669	4.1E+08	59869	323538	34
8/10-8/11 &	0		125895	4.4E+08	0		0		125895	4.4E+08	76698	202593	
08/12	0		122025	2.2E+08	0		0		122025	2.2E+08	74341	196366	40
8/14-8/15	0		158213	1.7E+08	6085	16734840	0		164298	1.9E+08	73992	238290	27
8/16-8/17	0		108386	83760774	0		0		108386	83760774	142512	250898	18
8/18-8/19	0		142656	3.8E+08	0		0		142656	3.8E+08	121530	264186	19
8/20-8/21	0		65382	6.7E+08	0		0		65382	6.7E+08	96240	161822	12
8/22-8/23	0		77907	55826791	0		0		77907	55826791	130343	208250	3
8/24-8/25	0		35968	43590514	0		0		35968	43590514	60178	96146	3
09/04	0		27	24	0		0		27	24	45	72	
09/15	0		736	18245	0		0		736	18245	1231	1967	
Subtotal	0	0	1471177	3.0E+09	28695	73024043	0	0	1499872	3.1E+09	889654	2389526	251

+ Proportions from 07/28 were used to partition the catch.

\* Proportions from 8/04-8/05 were used to partition the catch.

& Proportions from 08/12 were used to partition the catch.

Eshamy District 3/

Date	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
07/28	111	3958	775	27320	0		0		886	31278	61	947	
7/31-8/01	447	64497	3130	445232	0		0		3577	509729	246	3823	
08/04	1017	333558	7117	2302595	0		0		8134	2636153	560	8694	
08/08	1384	617696	9685	4284039	0		0		11069	4881735	762	11831	
08/10	898	260424	6289	1797740	0		0		7187	2058164	495	7682	
08/14	5077	8317478	35541	57416650	0		0		40618	85734128	2796	43414	
08/17	663	141972	4644	980056	0		0		5307	1122028	365	5672	
8/21-8/22	10162	33318209	71134	2.3E+08	0		0		81296	2.6E+08	5595	86691	8
8/24-8/25	1946	1222202	13624	8437024	0		0		15570	9659226	1072	16642	
8/26-8/27	2134	1469476	14939	10143989	0		0		17073	11613465	1175	18248	
08/28	864	240937	6049	1663219	0		0		6913	1904156	476	7389	
Subtotal	24703	45990407	172927	3.2E+08	0		0	0	197630	3.6E+08	13603	211233	8

3/ Proportions from 8/21-8/22 were used to partition the catch on all dates.

**Table 4.** Page 3 of 3.

Southwestern District

Date	AFK Hatchery		WN Hatchery		CC Hatchery		SG Hatchery		TOTAL HATCHERY		TOTAL WILD	TOTAL CATCH	NUMBER TAGS
	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance	Contribution	Variance			
07/25	10585	1.1E+08	0		0		0		10585	1.1E+08	0	10585	6
07/27 4/	13325	8762041	0		0		0		13325	8762041	6640	19965	9
07/29 5/	11100	6080728	0		0		0		11100	6080728	5532	16632	
7/30-7/31	46055	22810771	0		0		0		46055	22810771	4929	50984	
8/02-8/03	71260	45861963	0		0		0		71260	45861963	7626	78886	26
8/04-8/05	11535	36407860	7413	7336785	18533	12839373	0		37481	56584018	18976	56457	17
8/06-8/07	35827	44381617	8268	17752647	8268	26628970	0		52363	88763234	0	52363	19
8/08-8/09	87136	1.5E+08	0		0		0		87136	1.5E+08	0	87136	14
8/10-8/11	93821	1.2E+08	0		0		0		93821	1.2E+08	0	93821	13
08/12	90173	95174648	0		0		0		90173	95174648	35764	125937	5
8/14-8/15	118806	2.2E+09	0		0		0		118806	2.2E+09	0	118806	4
8/16-8/17	105766	1.2E+09	0		0		0		105766	1.2E+09	0	105766	20
8/18-8/19	141649	2.3E+08	0		0		0		141649	2.3E+08	8815	150464	38
8/20-8/21	43308	2.2E+08	0		10827	74359147	0		54135	2.9E+08	18887	73022	5
8/22-8/23	44676	2.3E+08	1547	2391269	0		0		46223	2.3E+08	14827	61050	34
8/24-8/25	48685	1.8E+08	0		4607	25421057	0		53292	2.1E+08	0	53292	15
08/27	57460	1.5E+10	0		0		0		57460	1.5E+10	0	57460	7
08/28	26215	4.5E+08	0	0	0		0		26215	4.5E+08	0	26215	4
Subtotal	1057382	2.0E+10	17228	27480701	42235	1.4E+08	0	0	1116845	2.1E+10	121996	1238841	236

4/ Proportions from 7/25 were used to partition the catch.

5/ Proportions from 7/30-7/31 were used to partition the catch.



**Table 5.** Survival rate and contribution to total catch by tag code of hatchery pink salmon returning to Prince William Sound in 1994.

Origin	Tag Code	# Tagged	# Released	Rearing Strategy	Estimate of % Survival	Standard Error	Lower 95% Conf. Limit	Upper 95% Conf. Limit	Contribution to Total Catch
A.F. Koernig	1301020811	13,509	7,976,770	Early Fed	3.145698	0.441131	2.28108	4.010316	250,925
	1301020812	13,371	8,178,517	Early Fed	1.705346	0.283914	1.148874	2.261818	139,472
	1301020813	13,371	7,992,494	Early Fed	0.138387	0.099071	0	0.332566	11,061
	1301020814	13,248	7,975,690	Early Fed	0.438167	0.154242	0.135851	0.740482	34,947
	1301020815	13,385	7,975,497	Early Fed	0.257798	0.096229	0.069188	0.446408	20,561
	1301020901	13,146	7,975,242	Early Fed	0.160592	0.075795	0.012033	0.30915	12,808
	1301020902	11,859	7,006,119	Early Fed	0.590062	0.214705	0.169239	1.010885	41,340
	1301020903	11,813	6,981,010	Early Fed	0.357228	0.149917	0.063389	0.651067	24,938
	1301020904	11,662	6,999,822	Early Fed	0.171454	0.078777	0.01705	0.325858	12,001
	1301020905	11,943	7,168,239	Early Fed	0.372202	0.184151	0.01705	0.325858	26,680
	1301020906	12,373	7,363,609	Early Fed	0.422415	0.148131	0.132077	0.712752	31,105
	1301020907	11,709	7,111,484	Direct Release	0.102991	0.082256	0	0.264214	7,324
	1301020908	11,701	7,045,612	Late Fed	6.993602	0.742799	5.537715	8.449489	492,742
	1301020909	11,860	6,975,193	Direct Release	0.371924	0.156926	0.064348	0.679499	25,942
	1301020910	11,538	6,916,286	Late Fed	7.066813	0.767675	5.562169	8.571458	488,761
	1301020911	11,109	1,695,761	Late Fed	8.720289	0.946697	6.864763	10.57582	147,875
W. Noerenberg	1301021012	20,757	12,688,033	Early Fed	5.344273	0.510004	4.344664	6.343881	678,083
	1301021013	19,901	12,036,519	Early Fed	5.248547	0.479511	4.308705	6.188389	631,742
	1301021014	19,562	11,900,957	Early Fed	3.4548	0.356042	2.756957	4.152643	411,154
	1301021015	20,087	12,105,181	Early Fed	3.405236	0.341749	2.735407	4.075065	412,210
	1301021101	19,973	12,003,572	Early Fed	1.693484	0.243266	1.216682	2.170286	203,279
	1301021102	19,910	11,976,571	Early Fed	2.204503	0.28845	1.63914	2.769866	264,024
	1301021103	19,819	12,016,427	Early Fed	1.85995	0.243324	1.383033	2.336866	223,500
	1301021104	21,118	12,727,191	Early Fed	2.837786	0.324476	2.201812	3.473761	361,170
	1301021105	20,036	12,167,539	Early Fed	2.265819	0.283359	1.710434	2.821203	275,694
	1301021106	19,690	12,003,914	Early Fed	3.076506	0.335001	2.419903	3.733109	369,301
	1301021107	19,901	12,020,607	Direct Release	1.588383	0.239975	1.118032	2.058735	190,933
	1301021108	20,194	12,022,492	Direct Release	1.532489	0.229462	1.082742	1.982236	184,243
	1301021109	19,808	12,063,272	Late Fed	8.870708	0.657025	7.582938	10.15848	1,070,098
	1301021110	24,201	14,352,158	Late Fed	6.99958	0.509936	6.000104	7.999056	1,004,591

Table 5. Page 2 of 2.

Origin	Tag Code	# Tagged	# Released	Rearing Strategy	Estimate of % Survival	Standard Error	Lower 95% Conf. Limit	Upper 95% Conf. Limit	Contribution to Total Catch
Cannery Creek	1301020912	16,457	9,951,523	Early Fed	8.05868	0.764006	6.561227	9.556131	801,961
	1301020913	16,713	9,982,219	Early Fed	5.755855	0.658355	4.465477	7.046233	574,562
	1301020914	16,618	9,941,026	Early Fed	5.528337	0.617083	4.318883	6.737852	549,573
	1301020915	16,808	10,031,625	Early Fed	7.200574	0.706065	5.816685	8.584463	722,335
	1301021001	16,449	9,974,576	Early Fed	7.242904	0.766623	5.740323	8.745486	722,449
	1301021002	16,055	9,977,249	Direct Release	5.390296	0.668785	4.079476	6.701115	537,803
	1301021003	16,596	9,974,215	Direct Release	7.12651	0.736764	5.682452	8.570568	710,813
	1301021004	16,534	9,967,084	Late Fed	9.539519	0.915365	7.745402	11.33364	950,812
	1301021005	16,767	10,073,962	Late Fed	7.724174	0.741958	6.269935	9.178412	778,130
	1301021006	16,600	9,973,185	Late Fed	9.441556	0.981971	7.516891	11.36622	941,624
	1301021007	16,945	10,162,835	Late Fed	6.636293	0.632046	5.397482	7.875104	674,436
	1301021008	16,648	9,957,657	Late Fed	6.116417	0.637359	4.867194	7.365641	609,052
	1301021009	16,802	10,066,503	Late Fed	5.692704	0.634167	4.449735	6.935672	573,056
	1301021010	16,534	9,996,737	Late Fed	3.644717	0.439522	2.783253	4.506181	364,353
Solomon Gulch	1301020508	51,650	31,028,437	Rel. into Bloom	7.934947	0.508379	6.938523	8.931373	2,462,090
	1301020509	50,158	29,948,159	Rel. into Bloom	11.15499	0.600435	9.978139	12.33185	3,340,714
	1301020511	30,358	18,237,547	Late Release	9.841	0.667663	8.551979	11.13002	1,794,757
	1301021302	66,651	40,031,900	Rel. into Bloom	9.773089	0.504779	8.78372	10.76246	3,912,353
	1301021305	6,724	4,161,909	Rel. into Bloom	7.780141	1.034944	5.751651	9.808632	323,802
	1301021310	30,223	18,457,283	Rel. into Bloom	5.604424	0.441809	4.738479	6.470371	1,034,424